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Reproducibility of Intracoronary Frequency-Domain Optical Coherence Tomography Quantitative Analysis Using Two Different Software Packages

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Background: Current frequency-domain optical coherence tomography (FD-OCT) systems acquire a large amount of data (100 frames/s) during long scans (54 mm) of coronary arteries. Therefore, offline analysis of FD-OCT pullbacks is laborious and time consuming, leading to the development of novel, advanced computer-assisted algorithms. In the current study, we tested the reproducibility of an algorithm that performs semi-automated lumen segmentation along with automatic strut detection and stent contours (QIVUS version 3.0, Medis Medical Imaging Systems, Leiden, The Netherlands) against the standard proprietary LightLab (version B.0.1., St. Jude Medical, St. Paul, MN) on an offline corelab workstation that requires manual segmentation of stent struts.
Methods: Quantitative analyses were performed on 193 FD-OCT cross-sections (0.6-mm longitudinal interval) obtained from 5 patients 9 months after stent implantation. Automated Z-offset adjustment was performed prior to each FD-OCT image acquisition, and manual corrections applied whenever needed. Raw format images and the same Z-offset calibration factor were used for the quantitative analyses performed on both softwares.
Results: Absolute differences between mean lumen (LA; 0.05±0.51mm^2) and stent (SA; 0.05±0.54mm^2) areas were low with high correlations between the two softwares (mean LA: R^2= 0.91, p< 0.001; mean SA: R^2 = 0.93, p< 0.001). Interclass correlation coefficients (ICC) were high, indicating high agreement of the two softwares for mean LA (0.95, 95% CI: 0.94 to 0.96, p< 0.0001) and mean SA (0.94, 95%: 0.93 to 0.96) p< 0.001) measurements. Mean absolute difference of neointimal thickness covering 1,847 matched struts was very low (0.01±0.00), with high ICC (0.94, 95% CI: 0.93 to 0.95, p< 0.0001) and concordance (kappa = 0.75, p< 0.001) between the measurements taken by the two softwares.
Conclusions: Quantitative analysis of FD-OCT images with novel computer-assisted algorithm demonstrated low variability and high agreement with the quantitative measurements obtained by manual stent segmentation on the proprietary offline software, being a valuable tool for faster and accurate quantitative analysis of FD-OCT studies.

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Assessment of coronary artery stenosis with frequency domain optical coherence tomography derived blood flow measurements: relationship with fractional flow reserve

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Background: The usefulness of fractional flow reserve (FFR) in evaluating functional severity of intermediate coronary stenosis is well established. Similarly optical coherence tomography (OCT) continues to be a promising imaging technique for the assessment of coronary artery disease. Frequency domain OCT (FD-OCT) overcomes many technical limitations of the time domain OCT (TD-OCT). The main objective of this feasibility study was to determine the correlation between measured FFR and FD-OCT derived blood flow measurements in coronary artery stenosis.
Methods: 20 coronary stenoses in 15 patients were assessed consecutively by quantitative coronary angiography (QCA), FFR and FD-OCT. ILUMEIN (St. Jude) percutaneous coronary intervention (PCI) optimization system was used in this study which combines wireless FFR measurement and FD-OCT imaging in one platform. Blood flow measurements in coronary artery stenosis which include stenosis resistance, blood flow velocity and FFR were derived from the volumetric analysis of the vessel segments imaged by FD-OCT.
Results: The mean age of the patients was 63±13 years. 11 patients (73%) were male. 12 patients (80%) had hypertension and 6 (40%) had diabetes mellitus. The most common studied vessel was LAD with 12 stenoses (60%). The FFR value was ≤0.80 in 5 stenoses (25%). The RVD, LL, MLD and %DS by QCA were 2.15±0.58 mm, 8±4.37 mm, 1.27±0.48 mm and 44.8±12.2% respectively. The mean MLD, MLA and %AS by FD-OCT were 1.36±0.39 mm, 2.39±1.15 mm2 and 63.4±12.8% respectively. A good and significant correlation between measured FFR and FD-OCT derived stenosis resistance (r = 0.77, p < 0.001), blood flow velocity (r = 0.74, p < 0.001) and FFR (r = 0.80, p < 0.001) was found. The RMSE between FD-OCT derived FFR and measured FFR was found to be ± 0.091 FFR units.
Conclusions: FD-OCT derived blood flow measurements in coronary artery stenosis showed good and significant correlation with measured FFR and can overcome many limitations of conventional measures of stenosis severity based on QCA and IVUS. With further validation and development FD-OCT derived these parameters have potential to become valuable tool for the assessment of coronary artery stenosis.

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Coronary Plaque Characterisation by Optical Coherence Tomography: An Inter-observer Analysis

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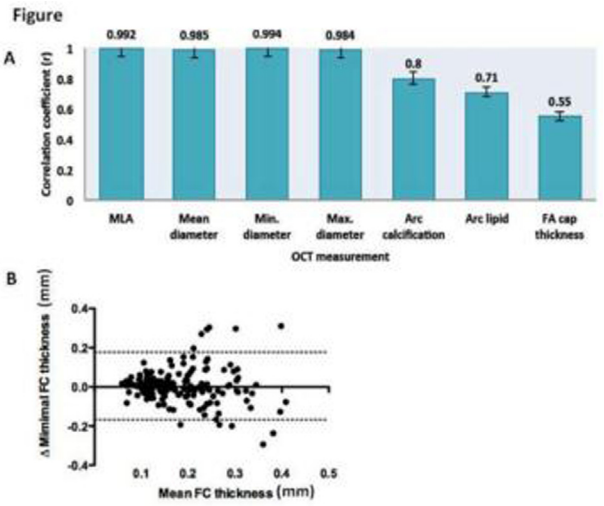
Background: Optical coherence tomography (OCT) provides unparalleled image resolution but quantitative assessment and plaque classification, particularly when defining thin-capped fibroatheroma (TCFA) may be prone to inter-observer error. We sought to assess the reproducibility of several OCT plaque imaging indices.
Methods: OCT (Dragonfly C7, StJude Medical) was undertaken in 50 patients and image analysis performed offline by two experienced operators. Culprit lesion luminal dimensions and plaque composition were assessed at the minimal luminal area (MLA) and at five 1mm intervals proximal and distal to the MLA (n=550). OCT FA was defined as plaque with >90° lipid arc (n=166); OCT TCFA had a minimum fibrous cap thickness (MFCT) of < 0.85µm. Analysis was performed using intra-class correlation coefficient for continuous variables and Cohen's Kappa for categorical variables.
Results: There was excellent inter-observer agreement for all luminal measures (1A p< 0.001). Agreement for plaque composition was stronger for calcified than lipid arc, whereas agreement on MFCT for FA was moderate. Bland-Altman analysis confirmed agreement was best when MFCT was thinner (1B) so that overall classification inter-observer agreement for FA (Kappa 0.64) and TCFA (Kappa 0.67) remained good.



Conclusions: Quantitative OCT is highly reproducible when assessing luminal size and geometry. Plaque compositional measures are affected by inter-observer variability. Better agreement is seen at thinner MFCTs, so that categorical agreement of TCFA remained good. Such findings are reassuring when utilising OCT to define vulnerable plaque phenotypes.

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Relation Between Malapposition And Thrombus In ST-segment Elevation Myocardial Infarction using Optical Coherence Tomography

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Background: This study was to confirm the relation between incomplete stent apposition and thrombus at early follow-up as assessed by optical coherence tomography (OCT) in stents implanted during primary percutaneous coronary